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(54) **Mechanical dishwashing system and apparatus.**

(57) An improved process and apparatus for the mechanical washing of dishes wherein said objects are placed on a horizontal rack or conveyor chain over an open reservoir or wash tank (A) containing a wash liquor comprising an aqueous cleaning liquid which is pumped and sprayed through spraying devices (K) placed over and/or under the rack or conveyor chain onto the dishes (C), subsequently followed by a rinse cycle wherein said washed dishes are sprayed with water optionally mixed with a rinse aid through spraying devices placed over and/or under the rack or conveyor chain, the improvement being that a bleaching and/or disinfecting agent (sanitizer) (H) is introduced into the cleaning liquid line (J) to the spraying devices and/or direct into the wash liquor in the tank before the start of the rinse cycle, thereby controlling the amount of sanitizer in the cleaning liquid at a sufficient strength.

EP 0 048 519 A1

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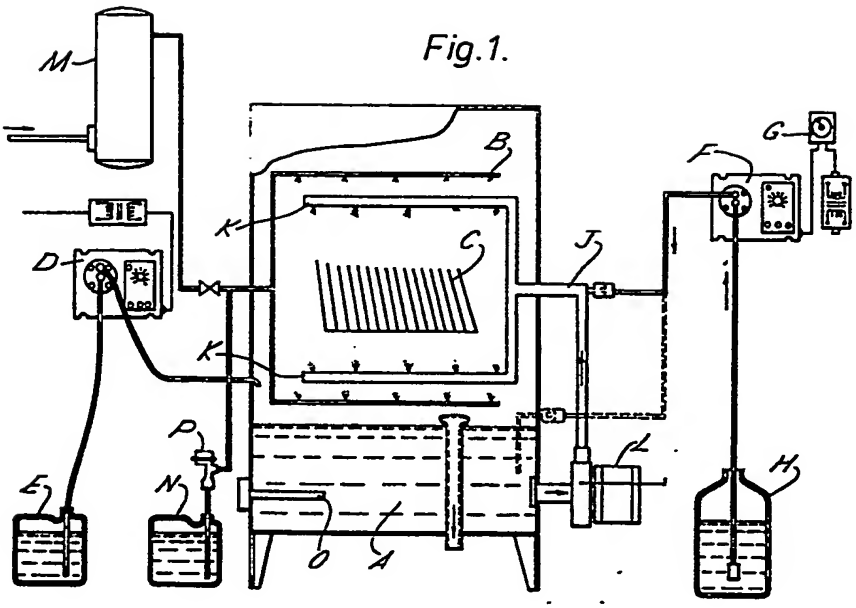
Fig.1.



MECHANICAL DISHWASHING SYSTEM AND APPARATUS

This invention relates to an improved process and apparatus for the mechanical washing of dishes. The term "dishes" is used here to include all sorts of crockery, glassware, cutlery and kitchen utensils.

Dishwashing machines wherein the dishes are placed on a horizontal rack or conveyor chain above an open reservoir or wash tank containing a heated wash liquor comprising an aqueous cleaning liquid and which operate by pumping and spraying said aqueous cleaning liquid onto the dishes for a predetermined period followed by a rinsing programme wherein the washed dishes are sprayed with warm water, optionally mixed with a rinse aid, are known.

Various types of dishwashing machines operating on the above principle are known.

A. Single tank "dump" machines

In these machines the wash liquor is dumped completely after each wash. They operate as follows:

1. Wash tank is filled with warm water and cleaning agent is dosed;
2. Wash cycle (circa 45 - 180 seconds);
3. Wash water is drained;
4. Machine is rinsed (optional);
5. Wash tank is filled with fresh warm water and rinse aid is

dosed;

6. Rinse cycle (circa 45 - 180 seconds);
7. Rinse water remains in tank and is used for the next wash cycle.

B. Single tank "re-use" machines

In these machines only part of the wash liquor is continuously drained via an overflow pipe and refreshed by water from the rinse. They operate as follows:

1. Wash tank is filled with warm or cold water (depending on local circumstances) and cleaning agent is dosed;
2. Wash cycle (circa 20 - 70 seconds);
3. Wash water stays in the wash tank;
4. Rinse cycle (circa 5 - 20 seconds). Rinse water from a warm water line at ordinary water pressure (1.5 - 3 bar) flows into the wash tank via rinse sprayers. Rinse aid is dosed into the warm water line during rinsing;
5. Water level in wash tank is kept constant by means of an overflow pipe (i.e. during the rinse cycle part of the wash water is drained);
6. Next wash cycle can start.

C. Multitank "re-use" machines

These machines generally operate as follows:

1. Tanks(pre-wash, wash and power rinse) are filled with warm water;
2. Machine is switched on (all sections have their own pump);
3. Cleaning agent is automatically dosed into the wash tank and rinse aid is dosed into the water of the final rinse;
4. Final rinse water (rinse water from a warm water line at ordinary water pressure (1.5 - 3 bar) flows into the final rinse section via rinse sprayers; it cascades over into the power rinse tank.
5. Water from the power rinse tank cascades into the wash tank, and from there it cascades over into the pre-wash tank, kept at a constant level by an overflow to the drain. The power rinse (= pumped rinse) prior to final rinse is necessary to

rinse away alkalinity and soil residues from crockery because the final rinse (with fresh warm water) is too short to obtain alkali-free and soil-free crockery.

Some multi-tank machine types do not have a power rinse section so that the final rinse water cascades into the wash tank.

These machines generally operate at a relatively high wash temperature of about 60°C and a rinse temperature of about 80°C.

The cleaning agents used in industrial mechanical dishwashing can be powders or liquids and are generally blends of two or more of the following compounds: sodium- or potassium triphosphate, sodium metasilicate, sodium- or potassium hydroxide, sodium carbonate, sodium sulphate, with or without a chlorine bleaching agent.

The current increasing demand to reduce energy and water consumption has led investigators to a reconsideration of mechanical dishwashing processes. Considering that lowering the wash water temperature from a nominal 60°C to 50°C, and lowering the rinse water temperature from a nominal 80°C to 60°C without further changing the timing of the machine programme involve an energy-saving of about 25%, it could be easily appreciated that one of the major objectives of investigators is to lower these temperatures in mechanical dishwashing processes. Lowering of the working temperature will also improve working conditions in the kitchen environment.

However, lowering the wash and/or rinse temperatures will obviously decrease the hygienic safety of the process owing to reduced thermodisinfection and higher risk of cross-contamination.

It is one object of the present invention to provide a process and apparatus for the mechanical washing of dishes, wherein washing and/or rinsing can be effected at lower temperatures without decreasing the hygienic safety of the process.

It is another object of the invention to improve the bleaching and hygienic performance of mechanical dishwashing processes.

It has now been found that the above objects can be achieved by the separate addition of a bleaching and/or disinfecting agent, which latter agent in the further description of the invention will also be referred to as "sanitizer".

Accordingly, in one aspect the invention provides a process for the mechanical washing of dishes, wherein said objects are placed on a horizontal rack or conveyor chain over an open reservoir or wash tank containing a wash liquor comprising an aqueous cleaning liquid which is pumped and sprayed through spraying devices placed over and/or under the rack or conveyor chain onto the dishes, subsequently followed by a rinse cycle wherein said washed dishes are sprayed with water optionally mixed with a rinse aid through spraying devices placed over and/or under the rack or conveyor chain, characterized in that a bleaching and/or disinfecting agent is introduced into the cleaning liquid line to the spraying devices and/or direct into the wash liquor in the tank before the start of the rinse cycle, thereby controlling the amount of sanitizer in the cleaning liquid at a sufficient strength.

In another aspect of the invention an apparatus for the mechanical washing of dishes is provided, comprising an open wash liquor tank, a moving or stationary horizontal rack for articles (dishes) to be washed placed above the wash liquor tank, a pump connected to the wash liquor tank for spraying wash liquor onto the articles through spray arms situated above and below the rack, an overflow to maintain the wash liquor level in the tank, and optionally a heating element mounted in the tank for heating the wash liquor, characterized in that there is provided a device for injecting a bleaching and/or disinfecting agent into the wash liquor.

Said injection device can be connected to the wash liquor line

at a point before or where the flow is split between the upper and lower spray arms, or direct to the wash liquor tank.

Preferably the injection points are provided with a one-way valve.

Bleaching and/or disinfecting agents usable in the present invention are, for example, alkalimetal hypochlorite and hydrogen peroxide. Also peroxy acids or peroxy acid precursors can be used. Depending on the manner of dosing, the sanitizer may be used in any physical form for convenient dosing, e.g. a liquid or a solid. If alkalimetal hypochlorite is used, it is preferably introduced in the form of an aqueous solution at a concentration of about 6 - 12% by weight. A preferred alkalimetal hypochlorite is sodium hypochlorite.

If hydrogen peroxide is used, it is introduced as an aqueous hydrogen peroxide solution, for example at a strength of about 3 - 60% by weight.

Hitherto separate addition of hypochlorite in mechanical dishwashing systems has been suggested via the rinse water. However, in most countries addition of hypochlorite or any other oxidative disinfectant to the final rinse water is prohibited by law, owing to the risk of the formation of undesirable residues on washed articles.

The present invention avoids the above risk and is safe in this respect.

The technical problem to solve is how and when to dose the bleaching and/or disinfecting agent solution of a fixed concentration to obtain the most cost-effective bleaching and/or disinfecting action. The reduction of hypochlorite, for example by organic soil in the wash liquor, will mean that, in order to maintain a constant active chlorine level, a regular dosing of hypochlorite would be needed but at a rate which varies with its

reduction by the organic soil present in the wash liquor. It was found that for a satisfactory bleaching and sanitizing effect the active chlorine content in the wash liquor should preferably be maintained at a level of at least 30 ppm per litre, particularly at a level within the range of 30-50 ppm per litre. It is easier to maintain this constant level if the bleaching and/or disinfecting agent is dosed during the wash process in pulses, preferably at least 30 seconds before the start of the rinse cycle, the amount being calculated on the basis of the amount of rinse water per rack or per hour and adjusted by means of the pulse frequency of the pump.

For example, in a single tank machine, having a wash tank content of 50 litres and a rinse water adjusted at 2.5 l/rack, this turns out to be approximately 625 g of hypochlorite solution (6% active chlorine) per 200 racks washed (i.e. 1.1 g sodium hypochlorite/litre).

To ensure that sufficient active chlorine or active oxygen is present in the liquor, the dosing pump for the bleaching and/or disinfecting agent may be activated by push button to deliver an extra "initial dosing" (i.e. a dose, yielding at least 30 ppm active chlorine level in a fresh liquor). In addition an extra amount of sanitizer may be needed to allow for variations in the intervals between two wash processes and in the soil load or soil composition.

Preferably a main wash product that contains more sequestrant than most conventional mechanical dishwashing products is used to improve the hygienic safety of the process even further. Both powder and liquid cleaning products can be used in the process of the invention. The powder product may be dosed via any commercially known "powder dosing" system, e.g. an overflowing reservoir system, and the liquid product may be dosed by a suitable pump. The product concentration can be kept within acceptable limits via a conductivity cell in the wash liquor and controller. Advantageously the aqueous cleaning liquid in the wash tank is kept at a strength at least

equivalent to 500 mg/litre sodium triphosphate per 1 mole M^{-3} water hardness and 200 mg/litre NaOH.

Under these conditions the level of residual bacteria found with the low temperature dishwashing process (washing temperature 50°C/ rinse temperature 60°C) is near that found with a conventional process at 60°C/80°C without hypochlorite. The combination of this alkaline liquor and the use of a separate sanitizer addition according to the invention results in an exceptional hygiene security and delivers a more cost-effective bleaching result than is possible with a conventional chlorine-containing main wash product.

The liquid bleaching and/or disinfecting agent, e.g. sodium hypochlorite solution or hydrogen peroxide solution, can be dosed by a diaphragm pump which is triggered by an electrical connection to the wash pump via an electrical device.

In single tank machines with sprays over and under the rack the sanitizer product is dosed preferably at a point in the wash arm of the machine before or where the flow is split between upper and lower spray arms. This injection point with a one-way valve is chosen to minimize the delay between sanitizer addition and contact with the articles being washed (i.e. to deliver a maximum instantaneous level of active chlorine or active oxygen on the articles). It should be noted that, typically, the recycle time of the wash liquor through the wash pump is 6-10 seconds so that dosing of the sanitizer into the wash liquor can also give very similar results. The dosing pump for the sanitizer is conveniently operable by push button for the initial dose (and intermittent bleaching when required), whereafter a fixed volume (about 3 g for 6% hypochlorite solution) is dosed per rack, starting e.g. 30 seconds before the end of the wash cycle. This dose may be injected in pulses of 1 g at time intervals, which will depend on the duration of the wash cycle.

The rinse aid can be dosed, as in the conventional processes,

with a Venturi or electrically operated pump.

The process of the invention not only avoids the risk of formation of undesirable residues on washed articles arising from the sanitizer, but is also operable at lower wash and rinse temperatures, producing bleaching and hygienic results that are at least equal to the results obtained with conventional high-temperature ($60^{o}/80^{o}C$) mechanical dishwashing processes. In the process of the invention the wash liquor temperature is preferably maintained at a level of about 50^{o} to $55^{o}C$, and the rinse water temperature is kept at a level of about 60^{o} to $65^{o}C$.

Further advantages of the invention are:

1. Level of active sanitizer/bleach in the wash liquor can be kept more constant than when dosed via a main wash product. The required level for effective bleaching and/or sanitizing can be set by adjusting:
   - the amount of dosage per rack and/or
   - the initial dose and/or
   - by manual repetition of initial dose.

   This makes better bleaching of washed articles and better disinfection of the wash liquor possible.

2. Presence of active sanitizer at an effective level in the wash liquor reduces risk of cross-contamination by bacteria (especially at lower temperatures, i.e. $<60^{o}C$), hence a hygienically safer process.

   Conventional mechanical dishwashing relies upon high temperature ($60^{o}/80^{o}$ C) automatic washing of articles with a properly formulated and dosed cleaning product. It is, however, conceivable that there could be serious faults developing with the washing of a particular load of used articles, resulting in reductions in temperature achieved, reductions in the dosage of the product achieved, and failure of one part of the cycle, for example rinsing. In extreme cases more than one of these might fail.

   If a serious fault develops in the process, it will undoubt-

edly result in a few articles being taken from the machine in an unsatisfactorily hygienic state. There is also the chance that contamination introduced into the wash liquor can be transferred to other articles. If large numbers of these would be involved, this cross-contamination could cause other washed articles to become hygienically unacceptable.

The present invention seeks to compensate for such faults that may occur.

3. Incompatible components in especially liquid main wash products can be used more effectively and more economically by the separate addition of sanitizer according to the invention.

The invention will now be further illustrated in the following Examples and explained by way of Figures 1 and 2.

Example 1

Process I using a liquid detergent product as cleaning agent (see Figure 1)

1. Fill the wash tank (A) with water of 50°C by means of the rinse sprayers (B) or a separate filling tap.

2. Put the rack with dirty dishes (C) in the washing compartment of the machine.

3. Start wash programme.

4. Push the button of pump (D); a pre-set amount of detergent is then dosed from the supply container (E) into the wash tank (A).

5. Push the button of pump (F) as soon as the pump is activated by the timer (G), which is indicated by lightening up of the green pilot lamp; a pre-set amount of bleach/sanitizer

is then dosed from the supply container (H) into the wash arm (J) or the wash tank (A).

6. The solution containing detergent and bleach/sanitizer is sprayed onto the dishes by the wash sprayers (K), which are being fed from the wash tank (A) by the machine pump (L).

7. During the last 30 seconds of the wash process pump (F) doses a pre-set amount of bleach/sanitizer into the wash arm (J) or the wash tank (A); the amount is calculated on the basis of the amount of rinse water per rack or per hour and adjusted by means of the pulse frequency of the pump.

8. After the dishes have been washed, they are rinsed with fresh water of 60°C from the water heater (M) by means of the rinse sprayers (B); to promote quicker drying of the clean dishes, a rinse aid is dosed automatically from the supply container (N) into the rinse water by means of pump (P).

9. With each subsequent rack the process repeats itself automatically, starting from 6. Detergent is dosed automatically during each wash cycle analogous to that described under 7 for bleach/sanitizer.

10. If the wash solution is dumped completely, the process has to be started again from 1.

Notes:

- In dishwashing machines with a separate power rinse section the bleach/sanitizer is dosed into the power rinse tank or power rinse line.
- In the above process the detergent concentration in the wash tank is kept sufficiently high by introducing a pre-set amount of detergent in the wash tank at the beginning of each wash cycle. It is also possible to use a conductivity control system to maintain the detergent concentration. Such a system is analogous to that used in Process II of Example 2 for powder detergents.
- If during washing the concentration of the sanitizer in the wash tank turns out to be too low (e.g. decrease of chlorine concentration by decomposition during a break), an extra amount can be dosed by pushing the button of pump (F).

Example 2

Process II using powder detergent product as cleaning agent (see Figure 2)

1. Fill the wash tank (A) with water of 50°C by means of the rinse sprayers (B) or a separate filling tap.

2. Add detergent powder to the dosing reservoir (C).

3. Put the rack with dirty dishes (D) into the washing compartment of the machine.

4. Start wash programme. Detergent solution/slurry is dosed automatically from the dosing reservoir (C) into the wash tank (A). Dosing continues until the concentration reaches a pre-set level. This level can be adjusted with the controller (E) which operates a solenoid valve (F) in the water supply line of the dosing reservoir (C). The controller monitors the concentration in the wash tank by means of an electrode (G, conductivity principle). The controller has a built-in alarm circuit which operates a buzzer and/or a pilot lamp to indicate that the reservoir has to be refilled with detergent powder. The dosing system is in operation as long as the machine is switched on.

5. Push the button of pump (H) as soon as the pump is activated by the timer (J), which is indicated by lighting up of the green pilot lamp; a pre-set amount of bleach/sanitizer is then dosed from the supply container (K) into the wash arm (L) or the wash tank (A).

6. The solution containing detergent and bleach/sanitizer is sprayed onto the dishes by the wash sprayers (M), which are being fed from the wash tank (A) by the machine pump (N).

7. During the last 30 seconds of the wash process, pump (H) doses a pre-set amount of bleach/sanitizer into the wash arm (L) or the wash tank (A); the amount is calculated on the basis

of the amount of rinse water per rack or per hour and adjusted by means of the pulse frequency of pump (H).

8. After the dishes have been washed, they are rinsed with fresh water of 60°C from the water heater (R), by means of the rinse sprayers (B); to promote quicker drying of the clean dishes, a rinse aid is dosed automatically from the supply container (P) into the rinse water by means of pump (Q).

9. With each subsequent rack the process repeats itself automatically, starting from 6.

10. If the wash solution is dumped completely, the process has to be started again from 1.

Notes:

- In dishwashing machines with a separate power rinse section the bleach/sanitizer is dosed into the power rinse tank or power rinse line.
- The above process can also be used for liquid detergents. In that case the powder dosing reservoir (C) and the solenoid valve (F) are not necessary; the controller operates a pump which doses the detergent from a supply container into the wash tank.
- If during washing the concentration of the sanitizer in the wash tank turns out to be too low (e.g. decrease of chlorine concentration by decomposition during a break), an extra amount can be dosed by pushing the button of pump (H).

C L A I M S

1. A process for the mechanical washing of dishes, wherein said objects are placed on a horizontal rack or conveyor chain over an open reservoir or wash tank containing a wash liquor comprising an aqueous cleaning liquid which is pumped and sprayed through spraying devices placed over and/or under the rack or conveyor chain onto the dishes, subsequently followed by a rinse cycle wherein said washed dishes are sprayed with water optionally mixed with a rinse aid through spraying devices placed over and/or under the rack or conveyor chain, characterized in that a bleaching and/or disinfecting agent (sanitizer) is introduced into the cleaning liquid line to the spraying devices and/or direct into the wash liquor in the tank before the start of the rinse cycle, thereby controlling the amount of sanitizer in the wash liquor at a sufficient strength.

2. A process according to claim 1, characterized in that the sanitizer is an alkalimetal hypochlorite.

3. A process according to claim 2, characterized in that the active chlorine content in the wash liquor is maintained at a level of at least 30 ppm per litre.

4. A process according to claim 3, characterized in that the active chlorine content in the wash liquor is maintained at a level of 30 - 50 ppm per litre.

5. A process according to any of the above claims 1 - 4, characterized in that the aqueous cleaning liquid in the wash tank has a strength at least equivalent to 500 mg/litre sodium triphosphate per 1 mole M^{-3} water hardness and 200 mg/litre sodium hydroxide.

6. A process according to claim 2, characterized in that the sanitizer is dosed into the cleaning liquid at least 30 seconds before the start of the rinse cycle.

7. A process according to any of the above claims 1 - 6, characterized in that the wash liquor is kept at a temperature of about 50^{o} - 55^{o}C.

8. Apparatus for the mechanical washing of dishes, comprising an open wash liquor tank, a moving or stationary horizontal rack for articles (dishes) to be washed placed above the wash liquor tank, a pump connected to the wash liquor tank for spraying wash liquor onto the articles through spray arms situated above and below the rack, an overflow to maintain the wash liquor level in the tank, and optionally a heating element mounted in the tank for heating the wash liquor, characterized in that there is provided a device for injecting a bleaching and/or disinfecting agent (sanitizer) to the wash liquor.

9. Apparatus according to claim 8, characterized in that said injection device is connected to the wash liquor line at a point before or where the flow is split between the upper and lower spray arms.

10. Apparatus according to claim 8, characterized in that said injection device is connected to the wash liquor tank.

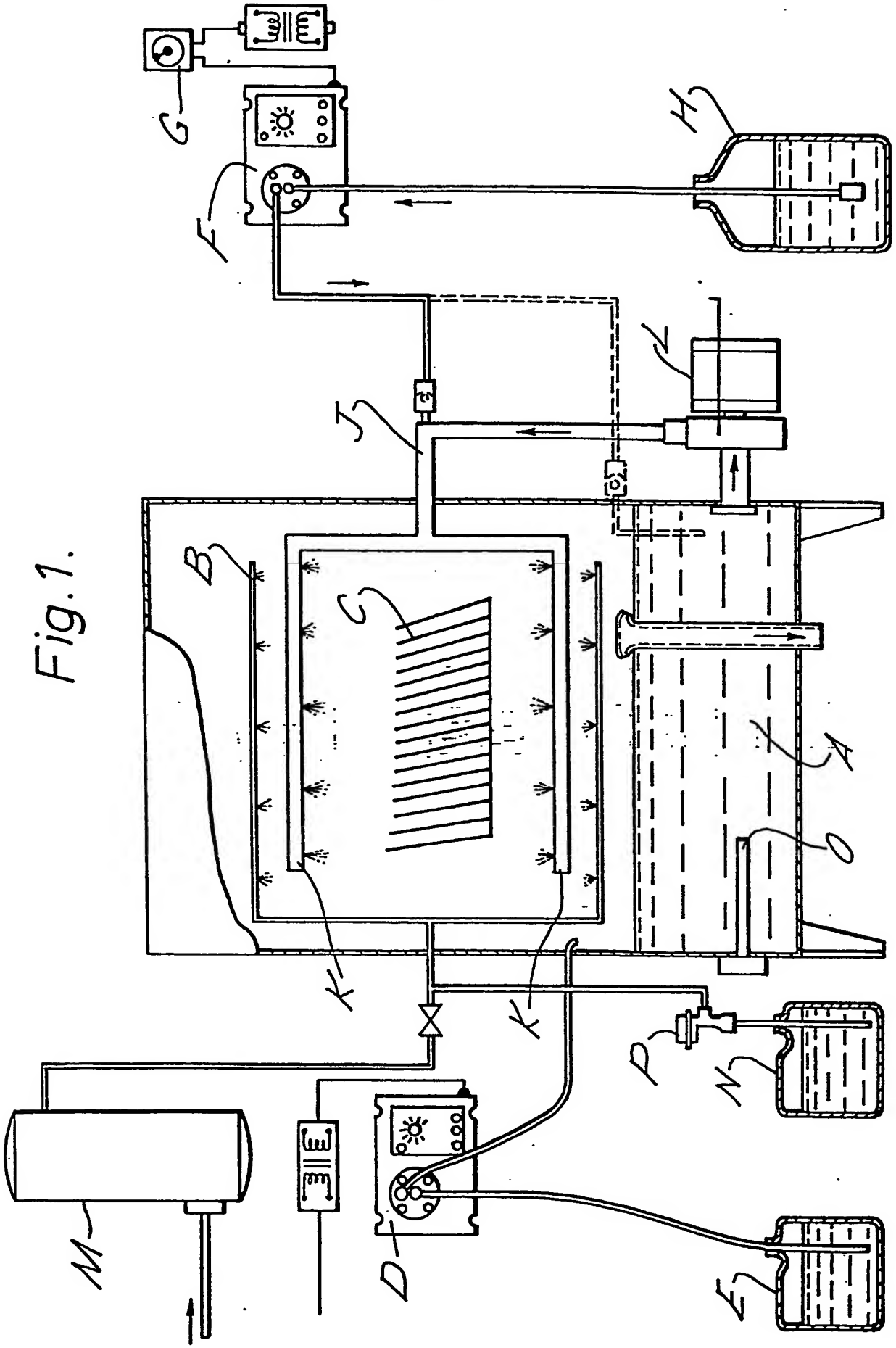


Fig. 1.

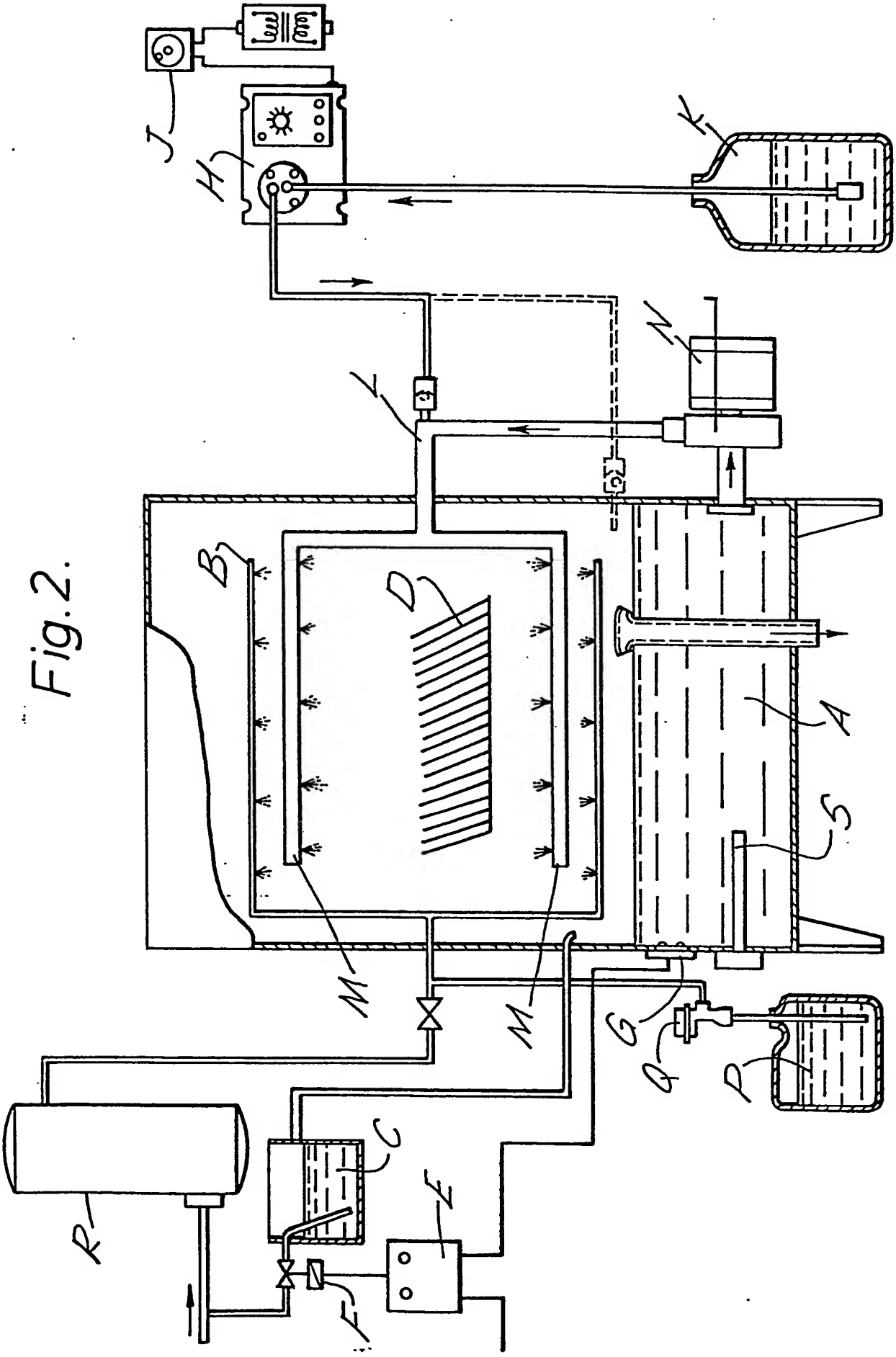


Fig.2.

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 81 20 1037.9

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
	EP - A1 - 0 001 356 (HOBART CORP.) * fig. 1 *	1,8	A 47 L 15/00
A	US - A - 4 218 264 (FEDERIGHI et al.)		
A	DE - C - 1 138 897 (SCHEFER)		
A	CH - A - 442 647 (ROWENTA)		

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

A 47 L 15/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
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O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	03-12-1981	KLITSCH

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